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RABIES ON SVALBARD IN THE SPRING OF 1980.
INFECTION DIAGNOSED IN ARCTIC FOXES, REINDEER AND RINGED SEALS

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AWARENESS OF RABIES IN NORWAY

In the last few years awareness of the danger of rabies in Norway has been increased by a widely based education campaign from the Veterinary Science Section of the Department of Agriculture. This campaign is closely associated with the stringent regulations applying to the importation of animals into Norway. The Veterinary Institute has had a specific diagnostic awareness of rabies for 10-12 years. Partly as a result of the educational campaign an increasing number of specimens from foxes, dogs and cats has been received and examined at the Virological Department of the Veterinary Institute. These specimens are largely from animals which have given rise to a more or less well-founded suspicion of rabies because of their unusual behaviour.

RABIES IN ARCTIC REGIONS

In Alaska rabies was diagnosed in the laboratory during a major epizootic in 1945-47 [10]. In 1957 rabies was discovered in dogs and foxes in the Arctic parts of the Soviet Union [4]. An etiological diagnosis of rabies was made in Greenland in 1959 [3]. The years indicate when the infection was identified. However, there is reason to believe that Arctic rabies has occurred for more than 100 years. Major epizootic outbreaks occurred in Greenland in 1957-59 in dogs, up to half of the dogs dying in some areas [9]. The Arctic fox (Alopex lagopus) is to be regarded as the reservoir and vector for rabies in Arctic regions. Rabies also seems to have occurred enzootically in Arctic foxes in recent years along the coast of Greenland. From occurring enzootically the disease may become epizootic in nature. Epizootic outbreaks of rabies in foxes have been associated with large annual litters, which in turn have been associated with years with large numbers of rodents. Migrations have occurred in such fox years in which the animals move over large distances. Major outbreaks of rabies in Arctic regions often coincide with fox migrations. The largest incidence of rabies in foxes has been seen in Greenland in the months of March and April. The majority of cases in Alaska have also been recorded in

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the winter. It was thought earlier that fox migrations occurred at intervals of 3-4 years. From around 1960 onwards this interval was found to be less regular. This is taken as an indication that the fox population has started to stabilise.

The virus which occurs in Arctic rabies has been regarded by many as a biovariant of the rabies virus which causes disease in other parts of the world. This distinction of a separate variant is based on relatively vague criteria. There is said to be a low incidence of Negri bodies in Arctic rabies. The paralytic form of rabies is said to be more clinically common than in the case of rabies in other climatic areas, and it has been claimed that Arctic rabies virus is relatively non-pathogenic in humans. It is possible that in the next few years newly-developed techniques will allow us to achieve considerably more in our efforts to find antigenic differences between various strains. This is a field which at present is at the centre of rabies research, particularly with regard to ensuring that the vaccine which is used gives the best possible cover against the virus which it is intended to protect against.

PRESENT-DAY SPECIES ON SVALBARD

The climate imposes very severe restrictions on animal life. There are scarcely any rodents, and the only naturally occurring mammals are polar bears (Ursus maritimus), reindeer (Rangifer tarandus) and arctic foxes (Alopex lagopus). Seals, walruses and whales are found in sea areas around the archipelago.

Dogs and cats are found in greatest numbers in the main settlements in Longyearbyen, Svea, Ny-Ålesund, Barentsburg and Pyramiden. There is a predominance of polar dogs. In the Russian settlements there are also cattle, pigs and hens.

CASE REPORTS

On 22 February 1980 a man came across a weakened and wounded fox at Pluto in Reindalen 3 kilometres south of Longyearbyen. The man received a superficial bite on the chin. The fox disappeared. The man cleaned the wound with cognac and consulted a doctor, suspecting rabies. On 6 March an aggressive fox then appeared in Longyearbyen. It tried to attack a man and later set on 2 polar dogs. The fox was killed by these dogs. Rabies was suspected at this stage, and the carcass was sent in to the Veterinary Institute where the diagnosis was made on 10 March. It was confirmed by Dr. J. Müller at the National Veterinary Serum Laboratory in Copenhagen on 11 March.

During the Spring months rabies was diagnosed in 11 other Arctic foxes when brain tissue was examined. Six out of a total of 12 positive foxes were found dead. Four of the 6 which were observed living were aggressive and had merely lost their natural shyness towards people, whilst the last one appeared sick and weak.

As shown by Fig. 1, by far the majority of cases were found relatively near to Longyearbyn and Svea. However, one of the foxes was found on Kongsøya which is approximately 300 km further east. This fox attacked a group of people who were on an expedition and was shot.

Rabies was identified in three reindeer. One of them was found dead. Another was observed over a period of 2 days. The animal constantly ran after the others, but the others moved away from it. The reindeer also ran after men and attacked snow scooters and a chopping block. It was described as having a bloody and ugly head with bloodshot, staring eyes. It was shot on 17 May at Vårsolbukta, Bellsund.

The third reindeer was observed at the airfield outside Longyearbyen when it pursued a fox. Later the reindeer started attacking the landing lights on the airfield and butted them to the extent that blood was drawn. The animal was shot on 1 June. Both of these last 2 reindeer had lesions which could be due to previous bite wounds in the leg.

A young ringed seal was found on the ice outside Ny-Ålesund on 28 April. It was approximately 200 m from the nearest breathing hole, and this is an unusally great distance [11]. The seal seemed confused and remarkably aggressive. It also had a wound on its hind part. The baby seal was brought into the station at Ny-Ålesund and placed in a respiration chamber as part of our research work. Gradually skin lesions appeared in its head with eruptions and oedemas and with pus from the eyes and mouth. It was slaughtered after a week. The head was sent in and rabies was diagnosed.

During the period March-June specimens were also sent in from Svalbard of 29 foxes which were caught, one fox which was found dead, 2 reindeer which died after a very short illness at the MAB station, a reindeer which died of natural causes, 2 dead seals, 4 apparently normal polar bears and an emaciated polar bear. All these specimens gave negative results.

DIAGNOSIS

Rabies can be diagnosed in several ways. The classical method is the identification of Negri bodies in the neurones under the microscope and specially-stained brain preparations. Brain material can also be inoculated into experimental animals and thus produce rabies. The most usual method is intracranial inoculation into young mice with identification of Negri bodies or immunological identification of rabies virus or rabies virus antigen. This identification is in the form of neutralisation of the infectivity in the inoculation preparation by means of antiserum before inoculation into the experimental animals, or by fluorescence microscopy of brain tissue from the experimental animals after inoculation.

The fluorescent antibody technique (FAT) has been used increasingly in recent years as an independent diagnostic method. Antibody (immunoglobulin) directed against rabies virus is conjugated with a dye which fluoresces in ultraviolet light. The conjugate which we have used in recent years contains antibody against the nucleocapsid of virus. This is purified virus without host cell components, prepared with a view to obtaining a reaction which is as specific as possible. The conjugate exists as two preparations. One of the preparations is absorbed with normal mouse brain and one with rabies mouse brain, in order to remove fluoresecence based on the non-specific antigen-antibody reactions and fluorescence based on the same non-specific reactions and on rabies antigen - rabies antibody reactions respectively. The product is made at the Pasteur Institute in Paris and is commercially available. 7-10 smears from different sections of brain are fixed in acetone, incubated with conjugate, washed and examined under the microscope in ultraviolet light. Characteristic fluoresence in cells stained with normal brain-conjugate without corresponding fluorescence in a preparation stained with rabies brain absorbed conjugate indicates rabies. Smears from rabies-positive and rabies-negative mouse brains are used routinely as controls. The method is fast and is considered to be very safe. It can be combined with the mouse inoculation method. This is done routinely if people have been exposed to animals suspected of rabies which primarily have been found negative by FAT.

During the outbreak on Svalbard the FAT method was taken as a basis, supported by mouse inoculations. There were no difficulties in interpretation in material from foxes and reindeer, even though some of the material was relatively greatly affected by storage. In the positive cases from these species

rabies virus antigen was identified in almost all smear preparations. The material from the seal presented some problems, since fluorescence was only identified in 2 out of 7 smears, and in the two the amount was extremely small, but characteristic. The seal brain was in a very poor condition when it arrived at the laboratory.

The material from various parts of the brain of the first fox and from the baby seal were inoculated intracranially into young mice. Those which were inolculated from the fox showed nervous symptoms after around 9 days and died quickly. The material from the seal gave vague symptoms in mice after 18-20 days, but on passing the incubation period was shortened and the symptoms became clearer and more specific. Rabies virus antigen was identified in mouse brains by means of FAT.

RETROSPECTIVE CONSIDERATIONS

The thought of rabies occurring on Svalbard is not new. Lønø [5] discussed various conditions in dogs and foxes in 1966 with particular reference to rabies. The author took as his point of departure a condition in sledge dogs on Svalbard in the 1964-1965 trapping season. The symptoms consisted of hair loss, a tendency to bite, balance disorders, blindness and paralysis. Some dogs died and some were killed. Because of this and other experiences questionnaires were sent to trappers on Greenland and Svalbard. The answers reported by Lønø [5] give limited information as far as Svalbard is concerned. The most interesting story came from the trapper Normann Andersen who in 1936 overwintered on Prins Karls Forland west of Spitsbergen. He was visited by a fox which showed a quite convincing and persistent aggressiveness. The fox was shot. Andersen had discussed the episode with many trappers but no-one was able to report anything similar.

After the diagnosis of rabies was made in March 1980, there were reports of animals which had acted suspiciously earlier. There is an account from Isfjord Radio of a litter of 5 Greenland dogs which at the age of just 1 year in August 1967 all suffered balance disorders, trembling and became aggressive. It was also said that blood came from the rectum. Four of the puppies were shot. However, the last of them lived for another six months.

In our search for possible signs of disease in foxes, information was collected from trappers and hunters who had been regularly active over the last few years. During the course of the last 10 years many sick animals had been seen, but this expressed itself largely in shabby and poor fur. This was the case in certain years, whilst in other years far less was seen of such conditions.

The same trappers have seen little of foxes showing abnormal behaviour over the last 10 years. One fox was shot because it showed some degree of obstinacy and came towards hunters and barked. This occurred during the grouse hunting in the period 1974-76. Similar behaviour was also seen in a fox in the autumn of 1979. From Bjørnøya there is a story of a fox which a few years ago attacked a man and which was found dead shortly afterwards. According to the information given, the fox was sent in for examination, but it did not come to the Veterinary Institute. It is also remarkable that it was very unusual to come across dead foxes out in the country before last winter.

Reindeer showing abnormal behaviour were also observed earlier. In 1978 there was an animal which did not show any fear of helicopters, and which appeared to be weakened and to have poorly coordinated movements.

The question of how long rabies has existed on Svalbard has often been asked recently. In this connection we consider it right to emphasise how hopelessly difficult it is to make a retrospective diagnosis. From mainland Norway a number of dogs, cats and foxes which have given cause to suspect rabies because of their unusual behaviour are examined each year. Until the present time all these examinations for rabies have been negative. Frequently there are no relevant organ changes either which could explain these symptoms on the basis of a non-rabies condition.

There are also other etiologically specific diseases in dogs and foxes which clinically can lead to rabies being suspected. Here we are thinking particularly of distemper and enzootic fox encephalitis (HCC). Both these infections have shown themselves to be significant in other Arctic regions [1], and they are of great interest in terms of differential diagnosis where rabies is concerned. A somewhat special state of affairs in Arctic regions is the polar bear liver poisoning which has been a well-known danger for people and dogs for several hundred years [7]. In this connection it should be mentioned that the litter of dogs at Isfjord Radio had received polar bear liver. Other types of poisoning in dogs undoubtedly can also lead to a suspicion of rabies. In situations where individual animals live for a long period with symptoms or recover, rabies can be more or less ruled out.

Against this background it is impossible to indicate any probability for rabies having been present on Svalbard for a long period. Such a situation also appears to be unlikely, not least in view of the fact that no inquiries had been made earlier to the Veterinary Institute with regard to rabies, in spite of the

fact that there are many responsible researchers within the field of biology with long experience from polar regions who have worked on the islands. Information from these sources also shows that there was an absolute accumulation of incidents involving animals suspected of rabies last winter.

EPIZOOTIOLOGICAL CONSIDERATIONS

The Arctic fox is the animal of greatest interest with regard to the occurrence and spread of rabies on Svalbard. The size of the fox population varies somewhat from year to year, but there is little information on this point.

In other Arctic areas it appears that the so-called fox years are more pronounced than on Svalbard. There fox years are linked with small rodent years. There are no lemmings on Svalbard, and the small local occurrences of mice must be assumed to be insignificant in the context of food, and consequently these years with easily accessible food for the fox do not exist.

The fox can migrate over the ice over very long distances, following the polar bear and feeding on the leftovers from the bear's seal hunting. It is natural to assume that this is the way in which the fox has carried rabies to Svalbard from another Arctic area.

Investigations from polar areas has indicated that a number of foxes are infected with rabies virus without the symptoms having been observed. This has naturally also been taken as a possible sign that the fox can be a carrier over a long period whilst remaining healthy. The extent to which this is the case, or whether it is merely a reflection of a long incubation period with a consequent long drawn-out clinical course without well-defined symptoms at the beginning, are questions which remain unanswered. Field studies published recently tend to indicate that foxes with identifiable rabies antigen in their central nervous system will develop rabies and die of the disease [8].

It is natural to believe that rabies will remain enzootic and relatively unnoticed in the fox population of Svalbard, partly because of a varying incubation period and a protracted course in some animals. Epizootic outbreaks will tend to occur in the winter as a result of increased contact between foxes and an increased struggle for food.

The reindeer population on Svalbard seems to have increased considerably in these last few years. It has been indicated that there are 10,000 reindeer on the archipelago. The animals lay down large deposits of fat in the summer, but have a very limited access to food in the winter. Ecologically the fox is

very close to the Svalbard reindeer. There is no hunting of reindeer, and such an unhunted population forms a good source of food for the fox, since many reindeer become old and weak. It is not unusual to find groups of 4-5 foxes at reindeer carcasses. They make a nest in the carcass and consume whatever is accessible as food. In view of this biological relationship between these species, it is not surprising that the disease is transmitted to reindeer from time to time during epizootic outbreaks of rabies.

It is much less obvious to expect cases of rabies in polar bears. Bears of various species have been found to be relatively resistant to rabies [6] even when relatively high doses of infected virus are inoculated into tissue. If it is imagined that the polar bear must first be attacked and bitten by a fox, and that the thick fur must be pierced by the teeth and saliva must be wiped off, it can be seen that polar bears will not easily be infected with rabies virus under normal conditions. The disease can be transmitted through the alimentary canal, most probably via the mucous membrane of the mouth and throat, but in a relatively resistant species this route of infection is very unlikely.

As far as we are aware, rabies has never before been diagnosed in seals. According to Øritsland [11] seals behaving abnormally have been observed in polar areas in Alaska at a relatively great distance from open water. The animals appeared to be confused. No more detailed studies were undertaken on these seals, and obviously their behaviour can only be considered as cooincidental to the findings on Svalbard. The extent to which it is probable that rabies occurs other than in exceptional cases is difficult to judge, but it is obvious to assume that rabies is rare in this species. To clarify this question the susceptibility of the seal to rabies could be studied experimentally. However, it would require very specialised facilities.

It should be mentioned in this connection that we recently received from elsewhere a seal which was to be examined with particular reference to rabies. This was a ringed seal from Østisen which was kept in an aquarium for research purposes. The seal suddenly became sick. It dribbled and bit woodwork and metal. The animal trembled constantly, and became increasingly aggressive and died. The seal was slightly cadaverous when we received it for examination compared with the material from the seal on Svalbard. This seal from Østisen did not have rabies, and there were other organ changes which could explain the clinical picture. This example is mentioned here to illustrate how risky it is to give a firm opinion as to whether an animal has rabies or not from superficial

clinical observations. It is a totally different matter of course to take the necessary action with regard to people exposed to animals which it is not possible to examine in the laboratory.

CONTROL MEASURES

All dogs and cats on Svalbard were vaccinated twice with an inactivated cell culture vaccine (Rabiffa, Meriux, France). The two dogs which had killed a rabid fox were slaughtered. Immunoprophylactic measures were taken for people exposed to the risk of infection [2]. Restrictions were imposed on the transport of animals and animal products between Svalbard and mainland Norway. Information on the risk of infection and how this can be reduced was given to the local population. The carcasses of positive or highly suspect animals were burnt with coal as far as this was practically possible.

P.S.

At the beginning of December 1980 a new case of Arctic fox rabies was identified at Isfjord Radio.

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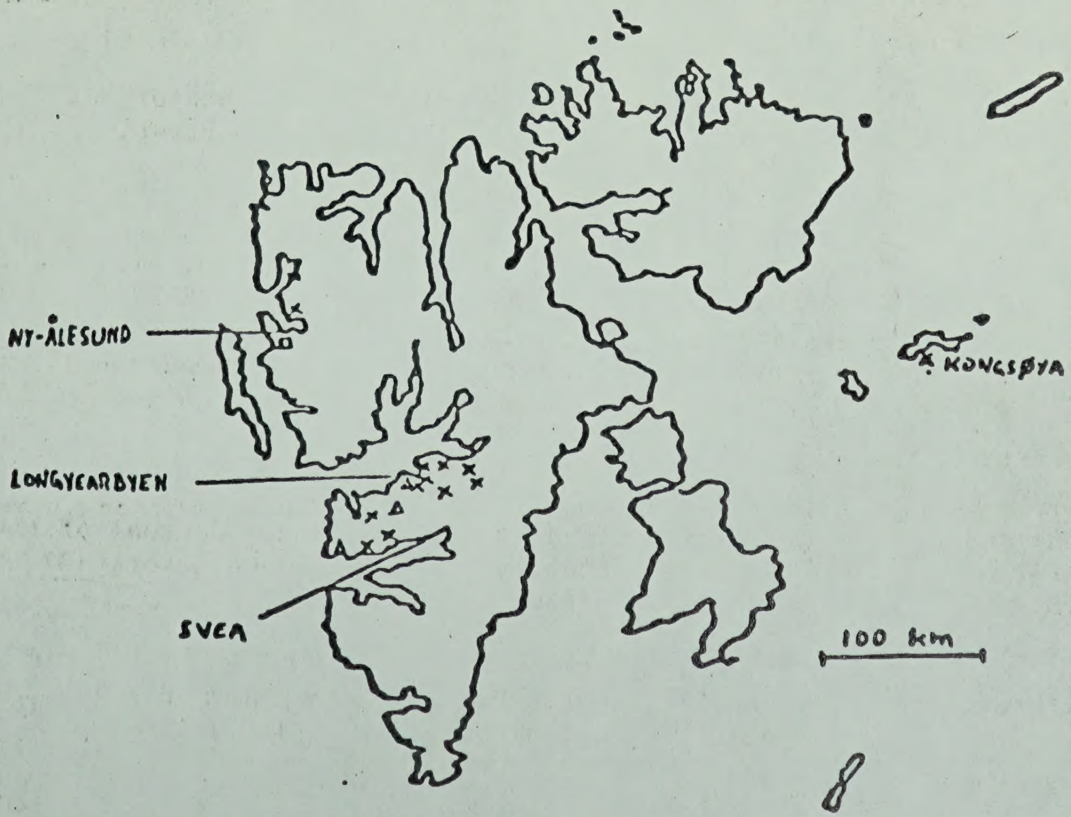

Fig. 1: Diagnosed cases of rabies on Svalbard, March-June 1980.

x Arctic fox (12 cases), Δ reindeer (3 cases), □ ringed seal (1 case).

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Abstract

In March 1980 rabies was diagnosed in Svalbard, Norway, for the first time. During the following four months rabies was also diagnosed in 12 Arctic foxes 3 reindeer, and 1 ringed seal. The various forms of wildlife to be found in the area are discussed. Several methods of diagnosing rabies are outlined. Epizootiological considerations are discussed, and from this it is thought that the infection was probably brought to the Arctic islands by migrating polar foxes. Control measures that may be introduced are considered.